

# Diethylaminoethanol

## Processing

**Chemical Name(s):**  
2-Diethylaminoethanol

**CAS Number:**  
100-37-8

**Other Names:**  
2-hydroxytriethylamine; diethyl(2-hydroxyethyl)amine;  
2-diethylaminoethanol; Diethylethanolamine; DEAE;  
N,N-diethyl-2-hydroxyethylamine; N,N-diethylethanolamine; N,N-diethylaminoethanol; n-diethylaminoethanol; beta-diethylaminoethanol; 2-N, N-diethylaminoethanol; N,N-diethyl-N-(beta-hydroxyethyl)amine; beta-hydroxytriethylamine.

**Other Codes:**  
NIOSH Registry Number: KK5075000  
UN/ID Number: UN2686

### Summary of Advised Recommendation \*

Synthetic / Non-Synthetic:	Allowed or Prohibited:	Suggested Annotation:
<i>Synthetic</i>	<i>Prohibited</i>	<i>None.</i>

### Characterization

**Composition:**  
 $C_6H_{15}NO$

**Properties:**  
Colorless liquid with a nauseating, weak, ammonia odor; hygroscopic; very soluble in water; soluble in alcohol, ether acetone, benzene, and petroleum ether; molecular weight 117.19; specific gravity 0.88-0.89 at 20/20° C; melting point -70° C; boiling point 163° C; flash point 60° C.

**How Made:**  
Manufactured by action of diethylamine with either ethylene chlorohydrin (Budavari, 1996), or with ethylene oxide (Ashford, 1995).

**Specific Uses:**  
DEAE is petitioned for use in boiler chemical systems to prevent carbonic acid corrosion in return lines. Other possible uses of concern to organic production and handling include use as an inert ingredient in pesticide formulations; as a chemical intermediate for production of emulsifiers, detergents, and solubilizers. DEAE is also an intermediate for manufacturing cosmetics; textile finishing agents, fabric softeners, and dyes; drugs and pharmaceuticals, and fatty acid. It is also used in antirust compositions, and acts as a curing agent for resins.

**Action:**  
DEAE inhibits corrosion by neutralizing carbonic acid in steam and steam condensates, and by scavenging free oxygen.

**Combinations:**  
Used in conjunction with cyclohexylamine, morpholine, and octadecylamine.

### Status

**OFPA**  
May be added to the National List as an equipment cleaner [7 USC 6517(c)(1)(B)(i)].

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\* This Technical Advisory Panel (TAP) review is based on the information available as of the date of this review. This review addresses the requirements of the Organic Foods Production Act to the best of the investigator's ability, and has been reviewed and commented on by experts on the TAP. The substance is evaluated against the criteria found in section 2119(m) of the OFPA (7 USC 6517(m)). The information and advice presented to the NOSB is based on the technical evaluation against that criteria, and is not intended to incorporate commercial availability, socio-economic impact, or any other factor that the NOSB and the USDA may want to consider in making their decisions.

**Regulatory****EPA/NIEHS/Other Appropriate Sources**

**EPA** - DEAE is an EPA List 3 inert ingredient.

Under the provisions of Section 311 of the Clean Water Act, DEAE is designated a hazardous substance if discharged in navigable waters 40 CFR 116 and 117. The Reportable Quantity (RQ) for notification is 5,000 lb/2,270 kg.

EPA proposed a rule to require manufacturers and processors of DEAE to report production and exposure-related data, which will be used for ranking substances for investigation and for preliminary risk assessments (45 *Fed. Reg.* 13646, 29 Feb. 1980). Data call-ins were done in 1986 (51 *Fed Reg.* 27562) and 1987 (52 *Fed. Reg.* 16022).

DEAE, as a tertiary amine, is an Interagency Testing Committee Candidate (53 *Fed. Reg.* 5466, 24 Feb 1988).

**NIEHS**Toxicity

Acute Toxicity: (abbreviations)

dose	mode	specie	amount	unit
LD50	ORL	RAT	1,300	MG/KG
LD50	IPR	RAT	1,220	MG/KG
LD50	IPR	MUS	308	MG/KG
LD50	SCU	MUS	1,561	MG/KG
LD50	IVN	MUS	188	MG/KG

AQTX/TLM96: Not available

Sax Toxicity Evaluation: THR=Moderate via oral and dermal routes.

Carcinogenicity: Not available

Mutation Data: Not available

Teratogenicity: Not available

Other Toxicity Data:

Skin and Eye Irritation Data:

skn-rbt 10 mg/24H

skn-rbt 500 mg open MLD

eye-rbt 5 mg SEV

Status: "NIOSH Manual of Analytical Methods" Vol 4 270, Vol 5, No. S140

EPA TSCA 8(a) Preliminary Assessment Information Proposed Rule

Hazard Class: 3    Subsidiary Risk: None    Packing Group: III

Labels Required: Flammable liquid

Packaging: Passenger: Pkg. Instr.: 309, Y309    Maximum Quantity: 60 L, 10 L

Cargo: Pkg. Instr.: 310    Maximum Quantity: 220 L

Special Provisions: None

**Handling Procedures**

Acute/Chronic Hazards:

This compound causes irritation on contact. When heated to decomposition it emits toxic fumes.

Minimum Protective Clothing: If Tyvek-type disposable protective clothing is not worn during handling of this chemical, wear disposable Tyvek-type sleeves taped to your gloves.

Recommended Glove Materials: P

The following gloves show the best resistance based on permeation testing. It is recommended that two different glove types be used for best protection. However, if this chemical makes direct contact with your glove, or if a tear, puncture or hole develops, remove them at once.

Suggested Gloves (RAD): Viton, Butyl rubber, Nitrile, PVA

**Recommended Respirator:**

Where the neat test chemical is weighed and diluted, wear a NIOSH-approved half face respirator equipped with an organic vapor/acid gas cartridge (specific for organic vapors, HCl, acid gas and SO<sub>2</sub>) with a dust/mist filter. Splash proof safety goggles should be worn while handling this chemical. Alternatively, a full face respirator, equipped as above, may be used to provide simultaneous eye and respiratory protection.

Storage Precautions: You should store this chemical under refrigerated temperatures, and protect it from moisture.

Spills And Leakage: If you should spill this chemical, use absorbent paper to pick up all liquid spill material. Seal the absorbent paper, as well as any of your clothing which may be contaminated, in a vapor-tight plastic bag for eventual disposal. Wash any surfaces you may have contaminated with a strong soap and water solution. Do not reenter the contaminated area until the Safety Officer (or other responsible person) has verified that the area has been properly cleaned.

Disposal And Waste Treatment: You should dispose of all waste and contaminated materials associated with this chemical as specified by existing local, state and federal regulations concerning hazardous waste disposal. It is suggested that your contaminated materials should be destroyed by incineration in a special, high temperature (>2000 degrees F), chemical incinerator facility.

**Emergency Procedures**

**Skin Contact:**

IMMEDIATELY flood affected skin with water while removing and isolating all contaminated clothing. Gently wash all affected skin areas thoroughly with soap and water.

IMMEDIATELY call a hospital or poison control center even if no symptoms (such as redness or irritation) develop.

IMMEDIATELY transport the victim to a hospital for treatment after washing the affected areas.

**Inhalation:**

IMMEDIATELY leave the contaminated area; take deep breaths of fresh air. If symptoms (such as wheezing, coughing, shortness of breath, or burning in the mouth, throat, or chest) develop, call a physician and be prepared to transport the victim to a hospital. Provide proper respiratory protection to rescuers entering an unknown atmosphere. Whenever possible, Self-Contained Breathing Apparatus (SCBA) should be used; if not available, use a level of protection greater than or equal to that advised under Respirator Recommendation.

**Eye Contact:**

First check the victim for contact lenses and remove if present. Flush victim's eyes with water or normal saline solution for 20 to 30 minutes while simultaneously calling a hospital or poison control center.

Do not put any ointments, oils, or medication in the victim's eyes without specific instructions from a physician.

IMMEDIATELY transport the victim after flushing eyes to a hospital even if no symptoms (such as redness or irritation) develop.

**Ingestion:**

DO NOT INDUCE VOMITING. Corrosive chemicals will destroy the membranes of the mouth, throat, and esophagus and, in addition, have a high risk of being aspirated into the victim's lungs during vomiting which increases the medical problems.

If the victim is conscious and not convulsing, give 1 or 2 glasses of water to dilute the chemical and IMMEDIATELY call a hospital or poison control center. IMMEDIATELY transport the victim to a hospital. If the victim is convulsing or unconscious, do not give anything by mouth, ensure that the victim's airway is open and lay the victim on his/her side with the head lower than the body. DO NOT INDUCE VOMITING. Transport the victim IMMEDIATELY to a hospital.

**Symptoms:**

Symptoms of exposure to this compound may include irritation of the eyes, skin and respiratory tract, nausea and vomiting.

**Firefighting:**

This compound is not very flammable but any fire involving this compound may produce dangerous vapors. You should evacuate the area. All firefighters should wear full-body protective clothing and use self-contained breathing apparatuses. You should extinguish any fires involving this chemical with a dry chemical, carbon dioxide, foam, or halon extinguisher.

Source: National Toxicology Program (NTP, 2001)

**Other sources –**

NIOSH Recommended Exposure Limits (REL): 10 ppm (40 mg/m<sup>3</sup>) Time Weighted Average (TWA), 15 ppm (60 mg/m<sup>3</sup>) STEL (Proposed)

OSHA Permissible Exposure Levels (PEL): 25 ppm, 100 mg/m<sup>3</sup> 29 CFR 1910.1000 (1996).

Transitional Limit: PEL-TWA 10 ppm (skin) [610]

Final Limit: PEL-TWA 10 ppm (skin) [610]

US Department of Transportation - Contained on the DOT Hazardous Materials Table (59 *Fed. Reg.* 67395).

Food and Drug Administration - Approved by FDA 21CFR 173.310 not to exceed 15ppm in steam and not approved for contact with milk and milk products.

**STANDARDS, REGULATIONS & RECOMMENDATIONS:**

ACGIH: TLV -TWA 10 ppm (skin) [610]

NIOSH Criteria Document:

NFPA Hazard Rating: Health (H): 3

Flammability (F): 2

Reactivity (R): 0

H3: Materials extremely hazardous to health but areas may be entered with extreme care (see NFPA for details).

F2: Materials which must be moderately heated before ignition will occur (see NFPA for details).

R0: Materials which are normally stable even under fire exposure conditions and which are not reactive with water (see NFPA for details).

State Right-to-Know Lists: Illinois (1991), Massachusetts (1994), New Jersey (1989), Pennsylvania (1989).

**Status Among U.S. Certifiers**

Not allowed by any U.S. Certifier. See the discussion regarding boiler water additives in the Steam Paper.

**International**

Canada – Not included in the list of permitted non-organic additives substances for organic food products (CGSB, 1999).

CODEX- Not in Annex 2, Table 4, 'Processing Aids' (FAO/WHO, 1999).

EU 2092/91 – Not in Annex VI, 'Processing Aids' (EU 2092/91).

IFOAM – Not on Appendix IV, approved processing aids and other products (IFOAM, 2000).

Japan — Not on the list of approved food additives (Woolsey, 2000).

**OFPA 2119(m) Criteria**

- (1) *The potential of such substances for detrimental chemical interactions with other materials used in organic farming systems.*  
As this is a processing material, the substance is not used in organic farming systems. Chemical interactions within a processing environment are discussed in the Steam Paper.
- (2) *The toxicity and mode of action of the substance and of its breakdown products or any contaminants, and their persistence and areas of concentration in the environment.*  
See processor criteria (3) below.
- (3) *The probability of environmental contamination during manufacture, use, misuse or disposal of such substance.*  
This is considered below under item (2).
- (4) *The effect of the substance on human health.*  
This is considered in the context of the effect on nutrition (3) below as well as the consideration of GRAS and residues (5) below.
- (5) *The effects of the substance on biological and chemical interactions in the agroecosystem, including the physiological effects of the substance on soil organisms (including the salt index and solubility of the soil), crops and livestock.*  
As this is not released into the agroecosystem, there is no direct effect.
- (6) *The alternatives to using the substance in terms of practices or other available materials.*  
See discussion of alternatives in the Steam Paper.
- (7) *Its compatibility with a system of sustainable agriculture.*  
This is considered more specifically below in the context of organic handling in (6) below.

**Criteria from the February 10, 1999 NOSB Meeting**

A PROCESSING AID OR ADJUVANT may be used if;

1. *It cannot be produced from a natural source and has no organic ingredients as substitutes.*  
DEAE cannot be produced from natural sources and has no organic ingredients as substitutes. When considering chemical means to condition steam lines in boiler systems, the additives to the steam lines must be volatile, so that they purposely travel along with the steam. There are no known non-synthetic boiler additives that can serve this purpose. However, steam can be produced from water without the addition of boiler water additives. A list of substances that are FDA approved for boiler water contact is attached. While these are not direct substitutes, these are available options. The NOSB has already recommended that several of these be listed. See the Steam Paper for more discussion.
2. *Its manufacture, use, and disposal do not have adverse effects on the environment and are done in a manner compatible with organic handling.*  
Diethylaminoethanol is produced from the reaction of diethylamine and ethylene oxide. Diethylamine is produced from ammonia and ethanol. The production of ammonia is covered in the TAP review for ammonium hydroxide. Ethanol can be produced by fermentation or synthesized from ethylene and was also previously reviewed by the NOSB. Ethylene oxide is a highly reactive gas that is extremely toxic. It is produced from petroleum refining. In the case of dehydration of diethanolamine (diethylaminoethanol), the production of diethylaminoethanol requires energy input to drive the synthetic reactions needed to make the material. Diethylamine is produced from ammonia and ethanol, or from ethyl iodide and ammonia. Ethanol can be produced by microbial fermentation, synthesized from ethylene, or by other methods (Budavari, 1996). These processes appear to have varying degrees of hazard to the environment.

Volatile amines are known to react in ways that produce carbamates and nitrosamines (Archer, 1996). These reactions are believed to be antagonistic to each other. Nitrosoamine formation and exposure via DEAE requires more study (Torén, 1996). While DEAE is not itself on the CERCLA list of hazardous wastes, it may be necessary in some jurisdictions and under some circumstances to handle it as such (NJ Department of Health, 1996).

3. *If the nutritional quality of the food is maintained and the material itself or its breakdown products do not have adverse effects on human health as defined by applicable Federal regulations.*  
DEAE is a poison by intraperitoneal (visceral) and intravenous routes (Lewis, 1989). Alkanolamines will decompose into aldehydes and ammonia. DEAE can revert to diethylamine (DEA) and ethanol. When DEA reacts with acidic periodates, it will convert to formaldehyde and ammonia (Bollmaier, 1993). Alkanolamines will also form nitrosoamines through nitrosation. A number of nitrosoamines are known or suspected carcinogens (IARC, 1978). A study conducted for NIOSH and the Nordic Expert Group for Criteria Documentation of Health Risks from Chemicals (NEG) concluded that there was remarkably little exposure data for DEAE, and that, among other things, studies for exposure to nitrosoamines formed from DEAE, basic toxicology, and cancer studies should be conducted (Torén, 1996).
4. *Its primary purpose is not as a preservative or used only to recreate/improve flavors, colors, textures, or nutritive value lost during processing except in the latter case as required by law.*  
The petitioned use is to prevent corrosion of boiler and steam line equipment. It does not serve as a preservative, or to recreate/improve flavors, colors, textures, or nutritive value lost during processing. It may have other functionalities, but the primary petitioned purpose does not have a functional effect on the food processed. The material does come into contact with organic foods though, which is the reason for the petition.
5. *Is Generally Recognized as Safe (GRAS) by FDA when used in accordance with Good Manufacturing Practices (GMP), and contains no residues of heavy metals or other contaminants in excess of FDA tolerances.*  
The FDA does not recognize Diethylaminoethanol as Generally Recognized as Safe (GRAS). The FDA sets a threshold for its use in steam that is in contact with food at 15 ppm. It is not permitted for use in dairy processing.
6. *Its use is compatible with the principles of organic handling.*  
Organic standards are precautionary when evaluating synthetic substances used in food. Volatile amines in general do not appear to be compatible with the principles of organic handling. They are synthetic, toxic, and are not necessary to produce any food. Given the environmental impacts of the manufacturing process and the adverse health effects from exposure, they do not fit within organic principles. Food processors generated and used steam for a long time without these chemicals. Many organic food processors have already adopted viable and practical ways to address corrosion. See the Steam Paper and reviewers' comments for further discussion.
7. *There is no other way to produce a similar product without its use and it is used in the minimum quantity required to achieve the process.*  
Culinary steam can be produced without the use of this chemical.  
See the Steam Paper and the reviewers comments for a further discussion.

## **TAP Reviewer Comments\***

### **Reviewer 1** *[Food Science and Nutrition Professor with inspection and certification experience]*

Diethyl amino ethanol is a neutralizing amine boiler additive used generally in combination with other neutralizing amines such as morpholine. Diethyl amino ethanol (DEAE) acts as a volatile basic amine capable of neutralizing carbonic acid in the steam and thereby prevents corrosion in steam lines and removal of oxygen. From an environmental position DEAE is recognized by the EPA List of Hazardous Substances and it is considered a hazardous air pollutant under the clean air act. OSHA has limited exposure to 10 ppm over an eight hour period where levels at 100 ppm or more are considered immediately dangerous to life or health (IPCS, 1993). . . It is made by chemical synthesis of diethylamine with ethylene chlorohydrin or with ethylene oxide. Therefore it is clearly synthetic.

Its status among US certifiers is a blanket "not allowed" and is not on the approved list of IFOAM and other international organizations. Disposal must comply with CERCLA. Therefore DEAE use, disposal or spill clean up as with other volatile amine boiler additives is not compatible with sustainable agricultural or processing systems. DEAE is not on the FDA Generally Recognized as Safe (GRAS) Listing and its use must not exceed 15 ppm based on toxicity studies. It is also not permitted in dairy processing. Overall use of DEAE as well as other volatile amines is not consistent with organic handling practices. Because of its toxicity, non-FDA GRAS approval and potential adverse effects on environmental and worker safety, I recommend that it be prohibited for all organic process operations where there is direct contact of steam to food.

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\* OMRI's information is enclosed in square brackets in italics. Where a reviewer corrected a technical point (e.g., the word should be "intravenous" rather than "subcutaneous"), these corrections were made in this document and are not listed here in the Reviewer Comments. The rest of the TAP Reviewer's comments are edited for identifying comments, redundant statements, and typographical errors. Any text removed is identified by ellipses [ . . . ] Statements expressed by reviewers are their own, and do not reflect the opinions of any other individual or organization.

There are many alternatives to the processing industry instead of using DEAE such as mechanical deaeration and ion exchange of incoming boiler feed water as well as deployment of high chromium, nickel and molybdenum stainless steel steam pipes (Moran and Natishan, 1993).

Advised Recommendation to the NOSB

In summary I recommend that diethyl amino ethanol be classified as:

1. Synthetic
2. Prohibited
3. Suggested annotation: For processing operations where there is direct steam to food contact.

Reviewer 2 [Consultant to organic certifiers]

. . . [D]iethylaminoethanol is considered a synthetic material. . . Diethylaminoethanol may also be used in food processing to obtain fatty-acid derivatives, as an emulsifying agent, and as a curing agent for resin (Winter, 1994). These uses will not be substantively covered in this review, as this is not the petitioners' request, but it could be deduced from the arguments below that these uses do not meet with acceptability under the OFPA and NOSB criteria for organic foods production.

Comments from the Criteria

Production of diethylaminoethanol requires energy input to drive the synthetic reactions needed to make the material. Diethylamine is produced from ammonia and ethanol, or from ethyl iodide and ammonia. Ammonia is produced by reacting nitrogen and hydrogen gases (also requires energy input). Ethanol can be produced by microbial fermentation, synthesized from ethylene, or by other methods; (Budavari, 1996). The hazards posed by these different processes may vary.

Diethylaminoethanol is a skin, eye, and respiratory irritant. [OSHA] recommends a variety of protective measures for persons working with this material, including skin and eye protection, and respirators (OSHA, 1978). Potential hazards of overexposure are nausea, vomiting, and irritation of the respiratory system, skin, and eyes (Budavari, 1996). It is immediately dangerous to life or health at 100 ppm, and its effects are felt at lower concentrations (Toxnet, 2001). These effects are observed in other mammals as well as humans (NTP, 2001). ACGIH recommends an upper limit of 2 ppm averaged over an 8-hour work period (NJ Dept. Health, 1996).

Diethylaminoethanol should be stored away from oxidizing agents and acids because of incompatibility. Contact with these chemicals gives a rapid exothermic reaction (Bollmaier, 1992). It is flammable when exposed to heat or flame, and can react with oxidizing materials (Lewis, 1989). Toxic gases and vapors may be released in a fire involving diethylaminoethanol; when heated to decomposition it emits toxic fumes of nitrogen oxides (Toxnet, 2001).

Diethylaminoethanol [*may be considered a hazardous waste*] (NJ Dept. Health, 1996), and is an EPA List 3 inert ingredient (EPA). . . [D]iethylaminoethanol raises significant concerns regarding its toxicological affects on humans, animals, and the environment.

The reaction of this synthetic material with organic foodstuffs may create a variety of synthetic by-products, the health implications of which are not completely known, especially over the long-term. There is no indication that addition of diethylaminoethanol to the processing stream has a beneficial affect on the nutritional quality of food. Mono- and dialkanolamines react readily with certain compounds to form carbamates; secondary amines give highly toxic nitrosoamines (Bollmaier, 1992). Diethylaminoethanol is a tertiary amine; interactions may be similar to these preceding categories, but this reviewer does not have references to cite for this. While it is possible that diethylaminoethanol may in some cases react with foodstuffs to create compounds otherwise normally found in the food during processing, such as browning compounds through the Maillard Reaction (Beattie, 1998), it is not known what all of the by-products of reactions of foodstuffs with diethylaminoethanol are or may be. . .

Historically, NOSB recommendations have been against the contact of any synthetic boiler additives with organic foods. All organic production and processing standards are in agreement that toxic substances should not contaminate organic foods. Organic certifiers in the United States, if they take a position at all on this issue, are consistent in repeating the prohibition recommended by the NOSB.

Live steam can be and is produced in many processing systems without the use of any boiler additives that carry over onto the food products. Boiler water can be treated in advance of use in the system by a variety of methods to soften, deionize, filter, and otherwise purify it. These steps reduce the need for addition of synthetic materials not on the National List to the boiler system. In some applications, the steam or heating system for the food may be changed to one where live steam is not the active agent, but rather heating (of food contents directly, or of steam in contact with food) is done via a heat

exchange system. The wide variety and individuality of processing systems which exist is indicative of the many ways in which the full range of processed food products can be made, without the need for toxic boiler additives to be used in contact with organic foods. This reviewer does not know of any food product type that absolutely requires diethylaminoethanol in steam which contacts organic food.

Justification of use of diethylaminoethanol by the petitioners is based on the constraints of their particular boiler and steam systems as they currently exist, and on the financial and/or logistical challenges involved with changing those systems so as to avoid contact of the organic food by the diethylaminoethanol. However, economic considerations are clearly not one of the criteria (either in OFPA or the final NOP rule) for determining the suitability of materials used in organic production systems.

History shows that quite often it has been the case that an organic operator (producer or handler) has had to make substantial changes to their system in order to be compliant with organic standards. These changes often involved redesigning of systems, practices, and techniques. In many cases, such changes resulted in the need for financial investment, as well as an investment in time. Some creativity on the part of the operator was often needed, to devise a new system. This has indeed been the case for certain processors, who made adjustments to their boiler systems or manufacturing practices in order to comply with the prohibition of contact of organic foodstuffs by synthetic boiler chemicals. The inconvenience of having to retool or readjust systems should not be the determining factor in whether or not such materials are added to the National List.

For certain processors, where organic processing events are not frequent, the boiler may be operated without the diethylaminoethanol for a limited time, without significant effect on the boiler or steam line system. For these operations, no retooling may be needed; instead, a procedure can be designed whereby it is verifiable that the volatile boiler chemical has been exhausted from the system prior to handling the organic goods.

For processors who intend to process frequently enough, or for long enough run times, redesigning of the system will be necessary, in one way or another. Prohibition on the use of volatile boiler chemicals can exist without consigning processors to premature deterioration of their equipment. It is often the case in industry that the creative process involved in redesigning systems has unpredicted benefits (short- and long-term) to the operator and the environment, in terms of long-term cost-effectiveness and sustainability; efforts in this direction should be encouraged, especially if not doing so results in a compromise of organic principles.

In fact, running boiler equipment designed for use with synthetic additives without the additives in place does lead to deterioration, and consequent lower efficiency of the system, which generally means greater energy consumption (Kohan, 1997). While greater efficiency of energy consumption seems undoubtedly to be desirable (both economically and ecologically), energy balance as a whole has not been considered as factor by the NOSB or certifiers when making determinations on the compatibility or allowability of materials or methods. To use such a factor as a criterion in the case for the volatile boiler additive is therefore inconsistent with the rest of the paradigm, and should not be a determining factor at this time.

#### Advised Recommendation to the NOSB

Diethylaminoethanol should be deemed a synthetic, prohibited material, and not be added to the National List for any purpose.

#### **Reviewer 3 [University staff in Food Science with inspection, consulting, and certification experience]**

##### General comments

Diethylaminoethanol (DEAE) is petitioned for use as a steam additive chemical to reduce corrosion in pipes. There could be direct food contact in many processing operations when steam is used to cook or heat food, such as in a blancher, cooker, canner, or other operations. DEAE has no functionality toward the food.

In the petition, page D-3 has the structure incorrect. It is only a 2 carbon chain to the right of the N, not a 3 carbon chain as drawn. . .

##### Comments based on the Criteria

There is sufficient evidence of potential adverse effects that precautionary action does not warrant allowing its use. . . The justification for use of [DEAE] is no different than trying to justify the use of a synthetic herbicide like Round-Up for organic farming, just because it provides a cheaper alternative to weed control and does not leave any detectable residue. Organic handling isn't about economics or end product testing, it's the process that's critical when evaluating compatibility with organic principles. Food processors generated and used steam for a long time without these chemicals. Many organic



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food processors have already adopted viable and practical ways to address corrosion without the use of DEAE.

There are other solutions that could be used to produce the desired result (no corrosion of piping). To summarize many of the citations reviewed, 'use of stainless steel piping completely solves the problem of corrosion.' The justification statement in the petition and the alternative control methods do not mention this as a possible solution. They do mention the costs of capital equipment and provide anecdotal evidence of the life expectancy and replacement needs should boiler water additives not be used, but provide no data to support this. There are numerous tests that can and should be performed periodically to determine the corrosion rates, (even with the use of inhibitors) to insure that equipment is being operated and maintained in a safe and efficient manner. Without confirming studies to show the differences in corrosion rates with and without the use of corrosion inhibitors, it appears that these petitioners are using anecdotal evidence to justify their continued use of cheap toxic chemicals instead of more expensive, but viable alternatives. There are several cited alternatives: stainless steel piping (suitable for all operations); discontinued use during organic processing (some operations); steam to steam heat exchanger (suitable for some operations); secondary boiler for food contact application only (suitable for all operations) that could be used. None of these are necessarily cheap, but all offer a viable alternative to the use of toxic chemicals.

Advised Recommendation to the NOSB

DEAE should not be approved for use as a boiler chemical for organic production.

**Conclusion**

The reviewers unanimously consider diethylaminoethanol (DEAE) to be synthetic, and unanimously advise the NOSB to not add it to the National List. Use should remain prohibited in organic handling.

**References**

See the Steam Paper.